RESCUE VICTIM RISK FACTORS AND SOLO WILDERNESS TRAVEL

by

Daniel W. Hadley

A thesis submitted to the faculty of
The University of Utah
in partial fulfillment of the requirements for the degree of

Master of Science

Department of Health Promotion and Education

The University of Utah

August 2014

The University of Utah Graduate School

STATEMENT OF THESIS APPROVAL

The thesis of **Daniel W. Hadley**

has been approved by the following supervisory committee members:

Jakob Jensen	, Chair	**March 28, 2014** Date Approved
Les Chatelain	, Member	**March 28, 2014** Date Approved
Richard Ingebretsen	, Member	**March 28, 2014** Date Approved

and by **Les Chatelain** , Chair/Dean of

the Department/College/School of **Health Promotion and Education**

and by David B. Kieda, Dean of The Graduate School.

ABSTRACT

Recreation in wilderness areas is growing in popularity. Wilderness Search and Rescue (SAR) groups are also seeing an increase in how many rescues are performed each year. Multiple potential risk factors have been studied in hopes to understand what might predispose someone to require Search and Rescue assistance, but more research needs to be done to explain this behavior. The following research will aim to identify the risk factors in Salt Lake County (SLCo) SAR victims from 2011 to 2013. It will also clarify what the risk is for trekking alone, and how it compares to other commonly studied risk factors.

Retrospective analysis was preformed of public SLCo SAR reports from 2011-2013. Analysis includes measures of central tendency for age, time of year, and solo travel. Frequency analysis was performed for gender, activity, location of residence, and chief complaint. An observational trailhead study of trekkers who were traveling alone or with a partner/group from June through September during 2013 is compared to the retrospective analysis.

From 2011 to 2013, mean age of SLCo SAR victims was 33.2 (*SD* ± 15.5). There were 102 males (67.1%) and 45 females (29.6%). The most common activity was hiking (65.1%). The majority were residents of SLCo (80.9%). Mean time of SAR page was 4:43 pm (*SD* ± 4.7 hrs). Thirty victims were alone (19.7%). Of the victims that were with a partner or group, at least one other person in the group required assistance from SAR

60.6% of the time. An independent group *t*-test revealed that solo backcountry travelers (M = 42.9, SD ± 18.28) differed from partner/group (M = 30.8, SD ± 13.71) victims with age as the dependant variable, t (df) = 37.77, p = .003. There was no significance in risk between partner/group travel and alone travel. Age did influence, but gender did not, whether solo victims called for help.

SLCo SAR victim demographics are similar to National Park victims. This research will be the first published for county SAR and the similarity to National Park victims shows that there is value in county SAR research and it should be studied more in the future. Travelling in the backcountry alone may not be as dangerous as previously accepted. Solo travel as a safe practice could change how people view the risks of backcountry travel. Lack of preparedness is probably the most significant risk factor for SAR victims as other commonly studied risk factors only show what demographic uses the backcountry for recreation.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

Wilderness

Wilderness means many things depending on who is defining it. It can be a place for beauty and solitude, where the useful resources of industry exist, or an intimidating uncivilized location that is best kept away from the bustles of city life. An American author, Edward Abbey (1968), expressed his own perspective: “We need wilderness whether or not we ever set foot in it. We need a refuge even though we may never need to set foot in it. We need the possibility of escape as surely as we need hope.” Wilderness areas, also referred to as backcountry, provide many opportunities for recreation. They also provide trails and terrain for physical activity, a necessity for a healthy lifestyle.

The Bureau of Land Management (2014) defines wilderness areas by the following criteria:

> They must be in a generally natural condition, have outstanding opportunities for solitude or a primitive and unconfined type of recreation, be at least 5,000 acres or large enough to preserve and use as wilderness, and contain ecological, geological, or other features of scientific, scenic, or historical value. (p. 1)

The reason for wilderness areas as defined by the Bureau of Land Management (2014) is "to secure for the American people of present and future generations the benefits of an

enduring resource of wilderness .... devoted to the public purposes of recreation, scenic, scientific, educational, conservation, and historical use."

President Woodrow Wilson, at the time the National Park Service began, said the fundamental purpose of the National Park Service (2013) is to "conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."

Wilderness shapes much of Utah. It comes in the form of National Parks, State Parks, Forest Service land, and more. Wilderness attracts people from all over the state, country, and world. It also brings locals from their homes to enjoy the beauties that can be found therein. There is no shortage of wilderness, or people to enjoy it, in Salt Lake County (SLCo). The population of SLCo is 1,063,842 (United States Census Bureau, 2013). The crowds of cars at trailheads and ski resorts show the popularity and ease of access to these areas.

The Wasatch Front is the area of mountains that sits to the east of the major populous of the state. The mountains that make up the Wasatch Front are the result of two tectonic plates that have come together with such force that the pressure is released upward. The prominence of the peaks, meaning the height from the valley floor below, is comparable to other big mountain ranges in the world. The result of this geographic behavior and the type of the rock layers are large, rocky mountains. They attract adventurers from all mountain sports for this reason. Some of the very reasons the mountains attract so many people are the same reasons that put these adventurers at risk.

Wilderness Activities

Mountains constitute much of the wilderness in SLCo. These wilderness areas are owned mostly by the United States Forest Service. Six major canyons through these mountains are accessible by vehicle from the city. Many other canyons exist that are only accessible by human-powered travel. All of these canyons provide access to several areas where one could participate in a variety of activities. In 2002, Salt Lake City hosted the Winter Olympics. Many of the events happened in SLCo, supporting that outdoor recreation is a major component of Utah, and especially SLCo.

Lakes, reservoirs, rivers, and creeks constitute the remaining wilderness in SLCo. The Great Salt Lake is one of these. It is the largest lake in the Unites States aside from the Great Lakes. It is the fourth largest salt lake in the world, with an average size of 1,700 square miles. The main marina for the Great Salt Lake and the area that requires the most water based rescue resides in SLCo. Sailing, kayaking, and canoeing are all popular activities in the waters of SLCo.

In a country where obesity and being overweight are becoming prevalent at high rates, any healthy and safe way to obtain cardiovascular exercise should be encouraged. (U.S. Department of Health and Human Services, 2012) Those that use the wilderness in SLCo for physical activity will find advantages that gyms and outdoor areas within the city cannot offer. These include clean air during times of inversion-related pollution, change in scenery, opportunity to see wildlife, and a quieter environment.

The wilderness areas in SLCo facilitate hiking, trail running, mountaineering, rock climbing, ice climbing, bouldering, kayaking, canoeing, para-gliding, resort skiing and snowboarding, backcountry skiing and snowboarding, snowshoeing, sailing, para-

sailing, snowmobiling, four-wheeling, and mountain biking. All of these activities involve risk. The inherent risk varies based on activity. Mountain biking, for example, can pose a higher risk than hiking because bicycle riders are typically moving faster, are farther off the ground, and the bicycle can get tangled in a crash. Moving at higher speeds than hiking is true for most of the aforementioned activities. Traumatic bodily harm is only one adverse consequence of outdoor recreation. Other risks involve getting lost, stranded (stuck in a cliff area), suffering from extreme temperatures, and risks associated with exercise such as exertional fatigue and advanced nutritional requirements.

Risks of Wilderness Recreation

Weather is one natural occurring cycle that making wilderness areas challenging. Cold and hot temperatures present different challenges against which to prepare. Cold weather preparation includes the use of warm clothing, eating and drinking adequately, and exercise. Hot temperatures are difficult to prepare for because drinking enough fluids and consuming electrolytes are the main steps that can be taken to avoid harm. Limiting exertion may be required to prevent harm in hot temperatures. Rain and snow can be prepared for by wearing clothing that is designed to repel water and still allow ventilation to occur. Lightning is a concern to be considered, but the reality is that very few people are actually killed by lightning strikes, especially within SLCo (Heggie & Heggie, 2008). Lightning strike prevention is accomplished by safe travel decisions that avoid high likelihood areas for lightning during a storm. Avalanches are a threat to anyone who travels in the backcountry in the winter months. Avalanches occur naturally or can be triggered by human impact. Avalanches can be unpredictable; however, there are ways to

measure the danger to a certain degree. Despite the danger, most winter backcountry travelers can be safe by practicing proper technique learned from training courses. These courses teach participants how to avoid avalanche terrain, recognize risks before they occur, and help someone who gets caught in an avalanche. Helping an avalanche victim is usually only successful if you are traveling with them.

Darkness is the other main naturally occurring event that increases risk in a wilderness environment. Preparedness for darkness is simply solved with the use of a flashlight or headlamp. A flashlight is not ideal for backcountry travelers because it requires the use of a hand. Scrambling in rough terrain and other tasks are made more difficult and sometimes dangerous with the use of a flashlight. A headlamp, however, can be secured to the head of a hiker and leaves both hands free. A light source may not be sufficient to prepare against all darkness-related challenges as it only illuminates the area immediate surrounding the individual. Short-distance navigation is accomplished successfully with a headlamp, but long-distance navigation can still be inhibited.

Another danger about wilderness travel is difficulty managing rough terrain. Rough terrain can come in the form of swift water, cliffs, loose rock, or any combination of the three. Often, a trail will have terrain dangers in multiple locations and require careful navigation. Bridges are typically, but not always, built at intersections of trail and swift water crossings. Trails also often skirt around exposed cliffs. The best way for safe travel is to avoid areas that are outside the ability and comfort of the traveler. Proper footwear and trekking poles can be useful for extra stability. Safe travel ultimately comes down to the backcountry user making smart decisions.

Getting lost is not necessarily a cause for alarm, particularly in short-term situations. Extended time being lost, or the addition of too many challenges while lost, can be a cause for alarm. The duration of being lost can exhaust the resources of even a prepared traveler. This length of time varies greatly and depends upon what supplies are carried by the individual. Carrying food and water, or the ability to obtain more of either, will support the needed energy for self-rescue. Warm clothing and possibly a fire starter are needed to stay protected from the elements long enough to either self-rescue or wait for outside help. Experience may lengthen the duration of time lost until exhaustion if the experience has built resiliency.

There are many navigational tools available to avoid getting lost. One accurate method used today is a combination of a Global Positioning System (GPS) and a map. Developing several skills is required before this method can be used. One needs to know how to use the GPS device to extract latitude and longitude coordinates, and then interpret them to where they can pinpoint that same location on a map. The map itself needs to have latitude and longitude markings for this to be possible. Being able to read a map and understanding what the users' location means for navigation are the other skills needed in this example. Disadvantages to using this system include inability for the GPS to obtain an accurate signal, and requiring charged batteries. Despite the barriers, GPS usage along with a map is the most efficient way to navigate once a person is lost, or to prevent getting lost. Another popular and traditional navigation method exists by using a map and compass, but they require an even greater skill set. Successful map and compass use also requires a reasonable knowledge of the terrain before getting lost.

One chief complaint (the reason for calling SAR) of rescue victims results from not carrying sufficient water. Running out of water while in the backcountry can make an uncomfortable situation dangerous. Hydration is needed for any physical activity and mountain sports are not excluded in this. Dehydration makes it difficult to thermo-regulate. Thermoregulation is accomplished primarily by the circulatory system via vascular dilation and by sweating. For sweating and vascular dilation to occur, sufficient fluid needs to be present in the body. Inadequate fluid intake can result in heat illness, mild hypothermia, and can blunt appetite (Subudhi, Askew, & Luetkemeier, 2005). Thermoregulation is critical in wilderness environments.

Proper caloric intake is needed to maintain optimal energy levels. The physically demanding nature of many backcountry activities requires optimal energy levels. Exercise requires additional calories than what the body normally needs. Our bodies can live a long time before dying from starvation, but they cannot perform optimally for a very long while in starvation (Askew, 2012). The most effective ways for the body to get energy are from glycogen stores and digestion. Glycogen stores are established prior to physical activities. That means the best way to get more calories that can be used for long-lasting physical activity occurs during the activity itself. Inadequate caloric intake can perpetuate any stressful situation found in wilderness recreation. The solution to this problem is to carry extra food when travelling in the wilderness.

The Ten Essentials

There is a commonly used gear list for backcountry travelers called the "Ten Essentials" (Mountaineers, 2011). The list is often modified and contains a greater

number than 10 depending on what the author feels is important to include. The original list was introduced by a mountaineering group in Washington State in the 1930s. Now the list is supported by the same group from their guidebook and has been used as a source of education by many agencies. It should be noted that it was created by mountaineers, an activity that requires some unique preparation. No list like this exists that is supported by academic research. The purpose of the "Ten Essentials" is to enable backcountry travelers to know what they need to bring when they travel in the wilderness. Most lists have some combination of the following: water, food, clothing, headlamp, map, compass, sun protection, first aid kit, fire starter, and a knife. The "Ten Essentials" is a list supported by many professional opinions in the outdoor community.

Most of the "Ten Essentials" have been discussed already regarding their role in backcountry danger avoidance. The others not mentioned so far do have value. Sun protection has minimal value for acute danger except in a few specific situations. One such situation is snow travel on a sunny day where sunglasses can prevent snow blindness. Some thermoregulatory benefit can come from wearing a hat in hot environments. First aid kits and a knife have many implications for usefulness during a survival situation, but offer minimal help with prevention. Headlamps are great to have in a lost situation when it gets dark. For prevention, headlamps may be the critical component if someone will need professional help.

Search and Rescue

Search and Rescue (SAR) is organized at the county level in Utah. It is typically part of the Sheriff's department. The National Park Service also performs SAR functions.

In counties where there is a National Park, county SAR teams will often work together with the Park Service in SAR operations. SAR members work on call at all times to respond to backcountry travelers that require assistance. Situations that utilize SAR include medical emergencies, locating lost or stranded people, and recovering deceased individuals. The terrain in wilderness areas can require these rescue functions to be performed in high angle, swift water, and/or avalanche terrain.

SLCo SAR consists of approximately 40 individuals, most of which are volunteers. They are trained in high angle, swift water, and avalanche rescue. All members are also required to have certified or licensed medical training. They respond to an average of 50 rescues per year (2001-2013), each rescue taking a little over 4 hours on average to complete.

Rescue Victims Demographics

Several potential risk factors for rescue victims have been postulated in recent research. This has provided valuable insight in understanding rescue victims, and their demographics. These demographical based risk factors include age, gender, experience of backcountry traveler, weather, time of year, activity, location of victim's residence, preparedness, and partner/group travel. The following tables reference the results of current literature in SAR victims.

Age

The mean age of rescue victims is consistent among studies (see Table 1). The main variation in standard deviation was in Denali National Park (DNP). The study for

Table 1. Age distribution of SAR victims in similar research (Ela, 2004; Hung & Townes, 2007; McIntosh, et al., 2010;Wild, 2008).

Study Location	**Year(s)**	**Results for Age**
Denali, AK	1990-2008	*M*=37.2, *SD*=10.4
Banff, Yoho, Kootenay NP, Canada	2003-2006	*M*=35.2, *SD*=17.0
New Hampshire	1999-2001	*M*=35.2, *SD*=17.9
Yosemite NP, CA	1990-1999	*M*=32.0, *SD*=16.0

DNP had results focused on mountaineering. The specific nature of mountaineering and the increased physical demands may explain the reason for this variation (McIntosh, et al., 2010).

One preparedness study of backcountry travelers in Yosemite National Park (YNP) in 1991 had a mean age of 34 years for the participants. Although research from 1991 is not current, and lacked SAR correlation, the cohort was related to some of the most current data regarding age. Age was similar (34 and 32, respectively) between the SAR and preparedness study participants in YNP (see Table 1). A possible explanation for why this is the age group with the highest frequency of needing rescue could be that more people travel in the backcountry at that age. This result, if true, would mean that the age groups surrounding the mid-30s travel more in the backcountry, but also make just as safe of decision as other groups (Kogut & Rodewald, 1994).

Gender

Males constitute the majority of rescue victims in all SAR studies (see Table 2). DNP had the highest rates of male SAR victims. The DNP study also measured participation of all visitors during the same time period. The results were that 90.4% of rescue victims were male, and that 90.2% of backcountry travelers on Denali were also male (McIntosh, et al., 2010). Similar gender frequencies between mountaineers and SAR victims show that more males visit Denali, but that their behavior is not riskier than females.

A second example supports that gender is not a risk factor for requiring SAR. From the YNP preparedness study mentioned in the last section, 63% of participants were male and 37% were female (Kogut & Rodewald, 1994). The gender distribution of this

Table 2. Gender of SAR victims in similar research (Boore & Bock, 2013; Ela, 2004; Heggie & Amundson, 2009; Heggie & Heggie, 2008; Heggie & Heggie, 2009; Hung & Townes, 2007; McIntosh, et al., 2010; Wild, 2008;).

Study Location	**Year(s)**	**Results for Gender**
Denali, Alaska	1991-2008	Male: 90.4% Female: 9.6%
US National Parks	2003-2006	Male: 66.3%, Female: 33.7%
New Hampshire	1999-2001	Male: 64.5%, Female: 35.5%
Banff, Yoho, & Kootenay NP	2003-2006	Male: 63.1%, Female: 36.9%
Utah National Parks	2001-2005	Male: 63.0%, Female: 37.0%
Yosemite NP, CA	1990-1999	Male: 62.0%, Female: 38.0%
US National Parks	2005	Male: 60.2%, Female: 39.8%
Yosemite NP, CA	2000-2009	Male: 55.5%, Female: 44.5%

study and the 1990-1999 YNP SAR study shows almost the same rates (63% and 62%, respectively). The explanation here could be the same as was found in the age section. More males are participating in backcountry activities and the result is that more males need SAR assistance. The trend in gender distribution from the YNP SAR study in the nineties increases for females in the YNP SAR study that followed the next decade (Boore & Bock, 2013; Hung & Townes, 2007). This trend could either mean that more females are traveling in the backcountry or that more females require SAR.

Experience

Experience in the backcountry can bring a safety factor to backcountry travel. It can be a resource for making good decisions by knowing how to avoid dangerous situations encountered in the past. Experience can help better prepare for wilderness activities and to understand the vulnerability that comes from not having the resources that are available in city life. The results from current research indicate that experienced backcountry travelers need professional rescue as much as beginners (see Table 3) (Boore & Bock, 2013). One reason this might occur is from experts applying familiar skills to unfamiliar wilderness areas. It might also be from overestimating their ability. Ninety-seven percent of rescue victims from Banff, Yoho, and Kootenay National Parks from 2003-2006 reported that inexperience and/or inadequate equipment was not a factor in needing rescue (Wild, 2008). Perception of the value of experience in backcountry travel may be a contributing factor for why experts do not have extra protection, but also why the inexperienced might push themselves outside their ability.

Table 3. Experience of SAR victims in similar research (Boore & Bock, 2013; Heggie & Heggie, 2008).

Study Location	**Year(s)**	**Results for Experience**
Utah National Parks	2001-2005	54% experts
Yosemite NP, CA	2000-2009	51% experts

Weather

Adverse weather is one reason wilderness travel is inherently dangerous. Forces of nature can contribute to whether someone will need rescue. Avalanches, lightning, storms, snow, high winds, visibility, and extreme heat and cold are present on a regular basis in the wilderness. Weather, however, has been shown to be a contributing factor in a small percentage of rescues (see Table 4). The challenges adverse weather present will likely not go away over time and therefore should not be ignored when talking about backcountry travel. So far, research supports that weather is a concern for wilderness travelers, but that there are greater issues.

Time of Year

Summer had the highest number of rescues for many areas (see Table 5). July and August produced the highest number of rescues for Canadian National Parks, each having at least twice the rescues as any other month of the year (Wild, 2008). Higher amounts of rescues occurring during the summer could be from more people traveling in the wilderness during those times. Yellowstone NP reported that 63% of injuries occurred during the summer. Yellowstone NP also reported that they receive 69% of their visitors during those months. Year-round rescue distribution has not been compared to the number of National Park visitors in the current literature other than at Yellowstone (Johnson, et al., 2007). It is noteworthy that summertime (June through September) is a busy time for SAR teams and prevention activities and interventions should be summer-based if possible.

Table 4. Weather at time of SAR incident (Ela, 2004; Heggie & Heggie, 2008).

Study Location	**Year(s)**	**Results for Weather**
New Hampshire	1999-2001	11.2%
Utah National Parks	2001-2005	8.2%

Table 5. Time of year of SAR incident (Hung & Townes, 2007; Wild, 2008).

Study Location	**Year(s)**	**Results for June-September**
Banff, Yoho, Kootenay NP	2003-2006	59.4%
Yosemite NP, CA	1990-1999	64.3%

Activity

There are many activities that can be participated in while in the backcountry. Table 6 shows the activity that produced the highest amount of rescues for each area. Hiking may not be the riskiest backcountry activity, however. Hiking competes with mountain biking, base jumping, wingsuit flying, climbing, skiing, and snowboarding for riskiest activity. Frequency of hikers should be compared to these other sports to better understand real risk. Hiking is not void of risk, but the level of risk is not understood without comparing to proportions of hikers and other activities. Motorized boating resulted in many rescues, especially at Glen Canyon National Recreation Area, but is not focused on here because of the lack of motorized boating areas in SLCo and other wilderness areas (Heggie & Heggie, 2008; Heggie, Heggie, & Kliewer, 2008).

Location

One potential risk factor for rescue victims is whether they live close to the wilderness area they go to. Location of residence can increase the risk of backcountry travel for both living close to and far away from the trailhead. Living close to a trailhead could increase risk for a hiker: if he is familiar with the terrain, he may not take the same precautions or make the same preparations he would on an unfamiliar trail. Conversely, it could also be the case that hiking a familiar trail is safer because the potential of getting lost is reduced and expectations for challenges are accurate. Hiking away from home may also make some people prepare more than normal because they are unfamiliar with the risks and terrain.

Three recent studies have looked at location of residence in relation to SAR incidences. Banff, Yoho, and Kootenay National Parks, from 2003-2006, had victims that

Table 6. Activity of SAR victims in similar research (Boore & Bock, 2013; Ela, 2004; Heggie & Amundson, 2009; Heggie & Heggie, 2008; Heggie & Heggie, 2009; Hung & Townes, 2007; Wild, 2008).

Study Location	**Year(s)**	**Results for Activity**
Yosemite NP, CA	2000-2009	Hiking, 57%
Yosemite NP, CA	1990-1999	Hiking, 52%
US NP	1992-2007	Hiking, 48%
Banff, Yoho, Kootenay NP	2003-2006	Hiking, 44%
US NP	2003-2006	Hiking, 32%
Utah National Parks	2001-2005	Hiking, 30%
New Hampshire	1999-2001	Hiking, 25%

were considered local (resided in the same province) in 50% of the cases (Wild, 2008). There is still a need to know how many locals actually travel in the wilderness. New Hampshire's rescue victims from 1999 to 2001 were considered local (resided within a 4-hour drive) 73% of the time (Ela, 2004). In US National Parks, fatality victims in 2003 and 2004 were not considered local (residing in the same state) in 69% of incidences (Heggie, Heggie, & Kliewer, 2008). So far, the data are inclusive regarding place of residence as a known risk factor.

Preparedness

Wilderness travel requires a specific level of preparedness. Every activity and wilderness location also has unique requirements for which to prepare. A summer in the Wasatch Front, for example, would demand additional water capacity for a person to be considered prepared. A hike at the same location, but in winter, would require additional warm clothing. Addressing preparedness in such simple terms may seem too obvious to include in educating wilderness travelers; however, preparedness-related issues account for a high number of rescues. These issues include darkness, fatigue, insufficient equipment, and insufficient information. Issues such as these accounted for 77% of causal factors in rescue victims in Utah National Parks from 2001-2005. Interpretation of causal factors was identified by National Park Rangers as they filled out the incident reports (Heggie & Heggie, 2008).

Yosemite National Park rescue victims, from 2000-2009, reported their own contributing factors, and preparedness was not one of them (Boore, 2013). Perception of preparedness did not equal real preparedness for these victims. There are two barriers to

overcome to address perception. One is to have education about what it means to be prepared. The other is adherence to the knowledge obtained from that education. What was learned from these rescue victims still does not differentiate between education and adherence. The difference in an interventional program that addresses education versus adherence is significant. It would be beneficial to better understand this connection, but it has not been researched as of yet.

In Utah National Parks, 11.4% of victims had issues relating to darkness. A question that cannot be answered here is whether having a headlamp or flashlight would have prevented the need for help in these cases. In the same study, 16.2% of victims needed rescue because of a lack of physical conditioning and fatigue. Conditioning is a possible preparedness issue. Fatigue is also recorded in other studies as a contributing factor. Reason for fatigue has not been studied, but could result from poor nutrition or hydration. Fatigue could also be a secondary contributing risk factor. Secondary risk factors may play a significant role in understanding rescue victims in the future, but there is not current literature addressing it. Secondary risk factor research would be beneficial for SAR prevention. Utah National Park rescue victims required rescue 49.6% of the time as a result of insufficient gear, experience, or information. If these were broken down into smaller categories, those categories could be the following: they lacked water, food, clothing, a map, or knowledge of the area or route. A combination of these categories was probably present as well. This study supports the need for the "Ten Essentials." It also supports the need for preparedness before participating in wilderness activities (Heggie & Heggie, 2008).

The current Yosemite National Park study sent questionnaires to individuals who were rescued from 2007 to 2009. The questionnaire asked whether the victim had certain items with them. It also asked whether they would have wanted certain items in their situation in hindsight. Ninety-one percent said they possessed sufficient clothing. Eighty-four percent said they possessed sufficient water. Seventy-one percent said they possessed sufficient food. Almost half said they had a headlamp with them. When they were asked if they would have wanted any more of those items, they said that they would not have wanted them. It is possible that most of them got into trouble because of reasons not associated with what they were carrying, but it is not likely (Boore & Bock, 2013).

Yosemite National Park rescue victims perceived that they did not need any more supplies at the time of rescue. Nobody has yet to study one cohort to assess whether rescue victims were carrying adequate supplies, and whether or not they perceived they needed more. Among the recent Yosemite National Park victims, experience was questioned. They found about half of the group said they were experienced, and the other half claimed to be beginners. One of the reasons the victims reported they required rescue was because of "bad luck" (Boore, 2013). The combination of the research in Utah National Parks and Yosemite National Park presents an issue with perceived risk associated with preparedness.

Partner/Group Travel

Most victims from the Yosemite National Park SAR cohort from 2007-2009 said they were with someone when they requested professional rescue. None of those travelling solo said they would have benefited from having someone with them. Of these

rescue victims, 75% had at least one companion (Heggie & Heggie, 2009). Travelling in a group is one risk factor that yields one of the highest percentages for rescue victims so far. It is unclear why this is the case. Of the research done so far, the number of victims rescued with a partner compared to the number of groups that travel has not been addressed.

Closing Note

Research Question 1: How do county search and rescue victims compare to National Park rescue victims?

Research Question 2: Are solo backcountry travelers disproportionate to backcountry travelers in a partner or group?

Research Question 3: Is there any evidence of group think?

A common theme that is needed from current literature regarding SAR victims is the proportions of risk factors compared to frequencies (Boore & Bock, 2013; Heggie & Heggie, 2008; Heggie & Heggie, 2009). One risk factor that has also been left without explanation is why rescue teams are helping more people that had a traveling partner or were with a group. The following research methods address both of these neglected areas to determine the effectiveness of proportional research in SAR victims and whether traveling in the wilderness with a partner or group is safer.

CHAPTER 2

BRIEF REPORT

Abstract

Objective

One objective is to identify the risk factors in Salt Lake County (SLCo) Search and Rescue (SAR) victims from 2011 to 2013. Another objective is to clarify what the risk is for trekking alone, and how it compares to other commonly studied risk factors.

Methods

Retrospective analysis was performed of public SLCo SAR reports from 2001-2013. Analysis includes measures of central tendency for age, time of year, and solo travel. Frequency analysis was performed for gender, activity, location of residence, and chief complaint. An observational trailhead study of trekkers who were traveling alone or with a partner/group is compared to the retrospective analysis.

Results

Mean age of SLCo SAR victims was 33.2 (*SD* ± 15.5). There were 102 males (67.1%) and 45 females (29.6%). The most common activity was hiking (65.1%). The majority were residents of SLCo (80.9%). Mean time that SAR was notified to respond

for assistance was 4:43 pm (*SD* ± 4.7 hrs). Thirty victims were alone (19.7%). Of the victims that were with a partner or group, at least one other person in the group required assistance from SAR 60.6% of the time. An independent group *t*-test revealed that solo backcountry travelers (*M* = 42.9, *SD* ± 18.28) differed from partner/group (*M* = 30.8, *SD* ± 13.71) victims with age as the dependant variable, $t(df) = 37.77$, $p = .003$. There was no significance in risk between partner/group travel and alone travel. Age did influence, but gender did not, whether solo victims called for help.

Conclusion

County SAR victim demographics are similar to National Park victims. Solo backcountry travel may not be as dangerous as previously accepted. Lack of preparedness is likely the most significant risk factor for SAR victims.

Brief Report

Introduction

Salt Lake County (SLCo) is located in northern Utah and is home to over 1 million people (United States Census Bureau, 2014). A large valley provides the land for residence surrounded by large mountains on both the east and west side. The Wasatch Front is a portion of the Rocky Mountains in northern Utah and the mountains on the east side of the valley constitute one section of the Wasatch Front. The mountains in SLCo have many miles of trails, multiple areas for rock climbing, ice climbing, and world famous ski and snowboard terrain. Four ski and snowboard resorts are located in SLCo.

The elevation of many peaks exceeds 3,300 meters (11,000 feet). The terrain is rugged and both summer and winter provide many opportunities for recreation.

SLCo Search and Rescue (SAR) is part of the Sheriff's Department and provides the majority of assistance to those that need assistance in the backcountry in the mountains, rivers, and a portion of the Great Salt Lake. Other professional agencies assist with SAR operations in SLCo and include local fire departments, the Department of Public Safety, local law enforcement, Wasatch Backcountry Rescue, Intermountain Life Flight, University of Utah Airmed, and others. SLCo SAR is made up of about 40 members who are mostly volunteers. They are all on call 24-7 and are notified via pager and Multimedia Messaging Service when SAR assistance is needed. They are all trained in wilderness medicine, ground searching, high angle rescue, swift water rescue, and avalanche rescue.

Little research on SAR victims has been done outside of National Parks (Ela, 2004). Fairly extensive research has been done on National Parks rescue victims (Boore & Bock, 2013; Forrester & Holstege, 2009). Resulting data have shaped the current image of risk factors by measuring age, gender, activity, location of residence, chief complaint, weather, experience, time of year, and traveling with a partner or group (Boore & Bock, 2013; Ela, 2004; McIntosh, et al., 2010).

Age of SAR victims is broad, but generally around the mid-30s (Hung & Townes, 2007; Wild, 2008). One study of backcountry travelers in Yosemite National Park (YNP) in 1991 had a mean age of 34 years for the participants (Kogut & Rodewald, 1994). The study population for this study was backcountry travelers, not SAR victims. Age was similar for SAR victims during the same study time (see Table 7). A possible explanation

for why the age group with the highest frequency of needing rescue could be that more people travel in the backcountry at that age. This result, if true, would mean that the age groups surrounding the mid-thirties travel more in the backcountry, but also are at no higher risk compared to other age groups.

Gender is leaning towards males in many studies, but not all (Boore & Bock, 2013; Ela, 2004). Hiking has produced many SAR victims (Heggie & Heggie, 2009). Locals require rescue, and long distance visitors require rescue (Heggie, Heggie, & Kliewer, 2008). Many chief complaints have been the reason for calling for help (McIntosh, et al., 2010). Many rescue victims call for help during good weather (Heggie & Heggie, 2008). Both the inexperienced and experienced backcountry travelers require SAR (Boore & Bock, 2013). Yellowstone National Park reported that 63% of injuries occurred during the summer (Johnson, Huettl, Kocsis, Chan, & Kordick, 2007). Yellowstone NP also reported that they receive 69% of their visitors during those months (see Table 7).

Two risk factors that have shown potential for defining the greatest area of concern is preparedness and partner/group travel. Preparedness issues have been shown in SAR victims in several studies (Boore & Bock, 2013; Heggie & Heggie, 2008). Even a potentially false perception of preparedness has been shown. Partner/group travel has produced more SAR incidents than solo travelers, but has left no explanation of why (Boore & Bock, 2013). One type of measurement that has not been widely adopted in SAR victims is the proportion of backcountry travelers to those requiring SAR assistance.

Table 7. Proportion Summary

Yosemite National Park	**Gender**	**Age**
Rescues (1990-1999)	62% Male	Mean = 32
Victims (1991)	63% Male	Mean = 34
Denali National Park	**Gender**	
Rescues (1991-2008)	90.4 % Male	
Victims (1991-2008)	90.2 % Male	
Yellowstone National Park	**June-September**	
Rescues (2003-2004)	63%	
Victims (2003-2004)	69%	

There is benefit to obtaining this type of data to better understand the significance of the previously mentioned risk factors (Boore & Bock, 2013; Heggie & Heggie, 2008; Heggie & Heggie, 2009). Gender has been studied in this way and has shown similar proportions for both males and females that travel in the backcountry and require rescue (McIntosh, et al., 2010). The methods in this study were designed to put County SAR victims in literature and to test the benefit of having proportions using partner/group travel as the risk factor to be measured.

Methods

The retrospective portion of the study included victims who required assistance from SLCo SAR from 2011-2013. One hundred forty-seven victims were included during this time. The data were collected from reports filled out by canyon patrol police officers. The canyon patrol police force handles all the logistics of SAR events and supports the volunteer-based team. SAR reports have consistent demographical information and a narrative write up. The SAR reports are considered public information and as such, the University of Utah International Review Board determined the study was exempt. IBM SPSS Statistics 21.0 was used for analyzing data. Suicides, suicide attempts, police evidence searches, and cases that involved mentally challenged individuals that wandered from their residence into wilderness areas were excluded. The motive was to include only individuals that were in the backcountry for recreation purposes.

The second aspect of the study was observational. Incident reports from 2011-2012 were evaluated to find the areas with the highest frequency of rescues. These areas were chosen for the observational portion. Backcountry travelers were counted and

categorized by either traveling alone or with a partner/group. The purpose for this part of the study was to get an idea of how many backcountry users are alone compared to how many require SAR. All rates that are calculated are based inferentially that the observed participants represent all backcountry users in the area during the study time. Four hundred forty-three backcountry travelers were counted from June to September, the busiest time for SLCo SAR (54.4% of rescues). Days and times were chosen at random to represent a variety of days of the week and most times of the day. Backcountry travelers were only counted on their way up or down depending on random assignment at each observation session from June through September during 2013.

Results

For the retrospective portion of the study, mean age was 33.2 (*SD* ± 15.5). There were 102 males (67.1%) and 45 females (29.6%). Hiking was the activity in 65.1% of cases. SLCo residents constituted 80.9% of rescues. Mean time of SAR page was 4:43 pm (*SD* ± 4.7 hrs). Thirty victims were traveling alone (19.7%). Of the victims that were with a partner or group, at least one other person in the group required assistance from SAR 60.6% of the time. An independent group *t*-test revealed that solo backcountry travelers (*M* = 42.9, *SD* ± 18.28) differed from partner/group (*M* = 30.8, *SD* ± 13.71) victims with age as the dependant variable, t (df) = 37.77, p = .003. The most common reasons for requiring SAR were being stranded, lost, and then injured (see Table 8).

The observations at various trails in SLCO that have historically produced the most rescues counted 107 (23.8%) solo travelers from June to September. No further statistical analysis was performed regarding reason for SAR call and traveling alone

Table 8. Reason for SAR call.
(n = 147)

	Frequency	**Percent**
Injury	40	27.2
Lost	41	27.9
Medical	11	7.5
Recovery	9	6.1
Stranded	46	31.3

because there were not enough victims rescued who were alone in all the categories. A chi-square showed that the number of alone backcountry travelers who needed rescue (30) was not significantly different than the number of backcountry travelers who did not need rescue (107) from the observational portion of the study (see Table 9).

A chi-square was used to see if gender influenced requiring SAR when travelling alone versus with a partner/group (see Table 10). The result was that gender did not affect SAR rates for solo travel or for partner/group travel. Group sizes of rescue victims were generally between 2 to 3 (see Table 11).

Discussion

Results from SLCo SAR victims were similar to National Parks findings in age, gender, time of year, and activity. This should help county SAR victims be comparable to other research. County SAR representation is low in research, but constitutes much of the SAR activity in the Utah. SLCo averaged 49 rescues over the 3 years of the study. The number of rescues increased by 14.3% from 2011-2012 and 18.8% from 2012-2013, but there is no information about an increase or decrease in hikers during these years. A closer look at solo backcountry travel showed that there was no safety factor to traveling with a partner or group. It also explained that SLCo SAR is assisting more partners and groups (79.6% of rescues) because more people go into the backcountry with someone (76.2% of backcountry users). It is commonly believed that one of the most important rules for safety in the backcountry is to go with someone. This study alone does not disprove that, but it does help to understand why SAR agencies nationally are reporting higher rates of partner/group rescue. Gender rates for rescues showed no higher risk for

Table 9. Pearson Chi-Square of alone and partner/group compared to observational data.
χ^2 (1, n = 596) = 0.73, p = 0.39

	Needed Rescue	**Hikers**
Alone	30	107
Not Alone	117	342

Table 10. Pearson Chi-Square of alone and partner/group with gender.
χ^2 (1, n = 147) = 0.94, p = 0.33

	Male	**Female**
Alone	23	7
Not Alone	79	38

Table 11. Rescue victim group size, 2011-2013.

Number in group	**Frequency**	**Percent**
1	30	20.4
2	81	55.1
3	16	10.9
4	9	6.1
5	10	6.8
8	1	0.7

either gender when traveling alone in the backcountry. Age of rescue victim did show a difference in risk. Older backcountry travelers were at a higher risk when alone.

Preparedness has been known to be an issue amongst those that require SAR. The concept of partner and group travel being no safer or more dangerous than to go alone is probably best explained by unpreparedness. Many social challenges can arise that require attention to communication to overcome. This is particularly evident with the result that 60.6% of rescue victims were with someone that also needed to be rescued. Group travel provides less of a safety barrier if the whole partnership or group cannot self-rescue.

Some possible reasons that partner/group travel is not safer could include the following: poor communication skills, not wanting to appear weak in front of others when safety issues arise, and relying on the skill or preparedness of others. Reasons that rates are not higher for solo rescue victims could be the following: taking extra time for planning, not being influenced by others desires and choices, and ensuring adequate gear is carried. There was a variety of reasons for needing SAR assistance, but lost and stranded occurred most frequently. Navigation issues are a big concern in SLCo mountains based on the chief complaints. From the average time of 4:43 pm for SAR to be paged, lack of a light source or fear of surviving the night may have prompted the motivation to call for help.

Limitations

The nature of observational data weakened the results by not provided data for the entire course of the study. It would have benefited the study to obtain a baseline dataset for age, gender, place of residence, weather, experience, and activity for backcountry

travelers that do not require rescue. There is the potential for self-rescued individuals that did not show up on SAR reports.

Conclusion

The commonly believed dangers of solo travel in the backcountry may not be as true as is often taught. Solo backcountry travel based on SAR incidents shows no difference in risk compared to partner/group travel. This finding should be used with caution when educating backcountry users as there is still benefits from having a partner in the backcountry. Additional research of a similar nature is needed to validate these findings for other areas. There is also great benefit to finding backcountry travel data to compare against SAR reports. This requires more time and yields smaller sample sizes, but the resulting data put risk factors into a much needed perspective. More effort should be placed on lack of preparedness, groupthink, risk perception, and preparedness perception as these seem to be the strongest contributing risk factors. The U.S. is facing issues with obesity and outdoor recreation is one tool that can be used to mitigate it. Safe practices in the backcountry are important to understand to provide positive experiences for those that seek exercise in the backcountry (U.S. Department of Health and Human Services, 2012).

Acknowledgments

The author would like to thank the Salt Lake County Sheriff's office for providing access to the SAR reports in a convenient manner. Also, thanks to Dr. Jake Jensen, Les Chatelain, and Dr. Rich Ingebretsen from the University of Utah for offering statistical and content advice.

CHAPTER 3

DISCUSSION

Design

The retrospective analysis was included in the research design because most of the published research has reported retrospective demographical data. One concern for taking a closer look at the dangers of partner and group travel within SLCo was that if any significant findings were produced, then it would not provide a strong relationship with current relevant literature. Two new concepts were designed for research with this study: introducing county SAR and evaluating partner and group backcountry travel behavior. The retrospective analysis provided that bridge to current literature. The results showed that there are similar qualities between SLCo and National Park.

The observational data collection took place on various days of the week and at different times of the day. This was done to represent the majority of possible times that SLCo trails are occupied. Data collection began in June and ended in September. The focus on this time of year was to gain as many participants as possible during the time of year that most rescues occur locally and nationwide. Data were collected from the trails where most rescues occurred. Trails included were Mt. Olympus, Corner Canyon, White/Red Pine, the Great Western Trail, Hughes Canyon, and Fergusson Canyon. The

time spent at each of these trails was relative to the number of rescues that occurred at each.

Comparison to National Parks

The age of rescue victims was similar to several other studies (see Table 12), as was time of year which the rescue occured (see Table 13). Gender of rescue victims was also consistent with National Parks (see Table 14). Hiking as an activity that produced the highest percentage of rescues was common for both populations (see Table 15). Place of residence results were informative, but not conclusive as has been found elsewhere. These risk factors did not produce any surprises, probably because the issues that cause backcountry travelers to require SAR in National Parks are the same for other wilderness areas. The terrain in SLCo is arguably just as rugged and remote as several other National Parks.

Risk Factors

Solo Backcountry Travel

Based on frequency of rescues, it would seem that solo backcountry travel is safer, if safe is defined by not needing to be rescued by SAR professionals. The problem with this definition is that if someone is alone and gets hurt or lost, there may not be any other option than to self-rescue, regardless of the difficulty. Survival situations can make people do extraordinary things. Such cases would not be shown in the data from this study. Reading from all of the narratives in the incident reports revealed that in most cases, SAR was notified by the use of cell phone from the victim himself. On occasion, a

Table 12. SLCo age comparison (Ela, 2004; Hung & Townes, 2007; McIntosh, et al., 2010; Wild, 2008).

Study Location	**Year(s)**	**Results for Age**
Denali, AK	1990-2008	*M*=37.2, *SD*=10.4
Banff, Yoho, Kootenay NP, Canada	2003-2006	*M*=35.2, *SD*=17.0
New Hampshire	1999-2001	*M*=35.2, *SD*=17.9
Yosemite NP, CA	1990-1999	*M*=32.0, *SD*=16.0
SLCo	*2011-2013*	*M=33.2, SD=15.5*

Table 13. SLCo time of year comparison (Hung & Townes, 2007; Wild, 2008,).

Study Location	**Year(s)**	**Rescues in June-September**
Banff, Yoho, Kootenay NP	2003-2006	59.4%
Yosemite NP, CA	1990-1999	64.3%
SLCo	*2011-2013*	*54.4%*

Table 14. SLCo gender comparison (Boore & Bock, 2013; Ela, 2004; Heggie & Amundson, 2009; Heggie & Heggie, 2008; Heggie & Heggie, 2009; Hung & Townes, 2007; McIntosh, et al., 2010; Wild, 2008).

Study Location	**Year(s)**	**Results for Gender**
Denali, Alaska	1991-2008	Male: 90.4% Female: 9.6%
US National Parks	2003-2006	Male: 66.3%, Female: 33.7%
New Hampshire	1999-2001	Male: 64.5%, Female: 35.5%
Banff, Yoho, & Kootenay NP	2003-2006	Male: 63.1%, Female: 36.9%
Utah National Parks	2001-2005	Male: 63.0%, Female: 37.0%
Yosemite NP, CA	1990-1999	Male: 62.0%, Female: 38.0%
US National Parks	2005	Male: 60.2%, Female: 39.8%
Yosemite NP, CA	2000-2009	Male: 55.5%, Female: 44.5%
SLCo	*2011-2013*	*Male: 67.1%, Female: 32.9%*

Table 15. SLCo activity comparison (Boore & Bock, 2013; Ela, 2004; Heggie & Amundson, 2009; Heggie & Heggie, 2008; Heggie & Heggie, 2009; Hung & Townes, 2007; Wild, 2008).

Study Location	**Year(s)**	**Results for Activity**
Yosemite NP, CA	2000-2009	Hiking, 57%
Yosemite NP, CA	1990-1999	Hiking, 52%
US NP	1992-2007	Hiking, 48%
Banff, Yoho, Kootenay NP	2003-2006	Hiking, 44%
US NP	2003-2006	Hiking, 32%
Utah National Parks	2001-2005	Hiking, 30%
New Hampshire	1999-2001	Hiking, 25%
SLCo	*2011-2013*	*Hiking, 65%*

travel partner would have to go to the trailhead to call for help. Some rescues were initiated because a stranded individual reached someone from another group by voice contact and communicated they needed help. No data were retrieved to quantify this because of the inconsistent style of reporting for how SAR personnel were notified from the victim. Further research could be useful by knowing how solo victims notify SAR compared to pair/groups. Mountain terrain is notorious for having poor cell phone reception, which is why many people like to travel in those areas. SLCo, however, has reasonably good cell phone towers with signal that reaches into some of the rugged terrain.

A closer look at why hiking alone appeared to be safer in other studies revealed new information in this study. The results showed no difference between hikers and rescue victims, concluding that hiking alone may not be riskier than hiking with a partner.

Age

Commonly in recent SAR research, younger victims had a higher frequency than older victims (see Table 12). This could again be the result of a higher frequency of younger backcountry travelers. The standard deviation for age was 15.5, which indicates that a nonspecific age group is at risk for needing SAR. This study has shown that travelling in the backcountry while alone resulted in more rescues for older populations. Reasons for why this occurred was not studied. Lack of adequate fitness, or an over-confidence in experience, might have affected the older population to require SAR. More research regarding age as a risk would be useful if the focus was on preparedness and perception of danger. Age has been reported many times in SAR research, but has not

yielded profitable results in obtaining information sufficient to base an interventional preventative SAR program.

Gender

Gender differences for solo travel did not exist in one YNP study, or this study (see Table 14). Looking at frequency alone would show otherwise, and supports the need for more research to measure trail usage before demographics of rescue victims are analyzed. The supporting reason is that males require more rescue than females, because more males travel in the mountains. Gender does not affect whether someone will require SAR for solo or partner/group travel.

Activity

The most common activity that resulted in participants requiring SAR was hiking in SLCo. This is also true for all other areas that have SAR victim research (see Table 15). SLCo had more hiking-related rescues than Utah National Parks. Some National Parks in Utah have large boating areas such as Glen Canyon Recreation Area. Boating has been an activity that has resulted in many rescues, but still not as many as hiking. Boating results in a high number of rescues in other National Parks as well, such as Gateway National Park in New York. Hiking remains the most dangerous activity based on how many rescues occur for hikers. Proportions of backcountry users that are hikers may change the perception of the danger since it is likely that more backcountry users choose hiking over other activities.

Research Questions

Research done in National Parks has shown that rescue frequency is higher for partners and groups. The methods of this study were designed to find out why. From the observational portion of the study, it was discovered that partner and group travel results in more rescues because there are more partners and groups that travel in the backcountry. Comparing the frequency of both found that there is not any difference in risk as to whether backcountry travelers are with someone or not.

The first research question was: How do county search and rescue victims compare to National Park rescue victims? Salt Lake County SAR victims are comparable to National Park rescue victims regarding age, gender, time of year, and activity (see Tables 12, 13, 14, and 15). More research will need to be performed at the county level to confirm whether these findings are consistent in other counties.

The second research question to be answered by this study was: Are solo backcountry travelers disproportionate to backcountry travelers in a partner or group? A chi-square test result revealed that there is no difference.

The third research question was formulated based on a hypothesis that there would be a difference and was stated: Is there any evidence of group think? With the negative answer to research question one, the value of research question two was lessened. A *t*-test was still preformed, as well as further chi-tests to better understand the risk factors of backcountry travel. The risk factor that seems to be of most significance is preparedness.

It was hoped that a better understanding would come from this study regarding demographical variables, and there was. Results from current literature do not support

any variables to be significant when designing a preventative SAR program. Further research could be useful in perceived risk, understanding preparedness, and adherence to known preparedness facts. Knowing which of these is most prevalent would provide enough information to start designing a preventative SAR program tailored to specific areas. Backcountry travelers were found to read a trailhead sign 64% of the time, which supports that a simple interventional program could be successful (Duncan, 2002). Unfortunately, there is not very much other data to show effectiveness of interventional programs for wilderness travelers.

Proportions Review

There have been a few studies that have looked at proportions in SAR victims (see Table 7). Proportion-based research changes the perception risk factors. The conclusion from what little research has been done shows that males in their early 30s hiking in the summer are at the highest risk for needing assistance from SAR. The reality is that more males in their 30s travel in the backcountry during the summer, but that their behavior is not likely any riskier than other backcountry travelers. Also, it has been shown now that there is no difference in risk from solo hikers to partners and groups. There is still additional research that should be done using proportions for activity, weather, location of residence, and experience of the individual.

Interventions

Many intervention programs are in existence such as and “Preventative Search and Rescue (PSAR)” and “Know Before You Go.” PSAR began in 1997 with the NPS in

Grand Canyon National Park. The program consists of rangers who patrol trails and trailheads to ask hikers questions about preparedness. The goal is help hikers be aware of the risks that are inherent with their hike. There is minimal information on the NPS website regarding this program or any research about the effectiveness of it.

Know Before You Go is an avalanche awareness program that began in 2004 by the Utah Avalanche Center (UAC). It is an educational program that consists of a video and lecture regarding the dangers of avalanches and how to avoid them. The content is basic to attract the target audience of those unfamiliar with avalanches. The design initiated by the UAC has been adopted in many other agencies including the NPS. No published research has been conducted regarding the effectiveness of this program either.

Conclusion

The results of this study did not portray any demographic variables as high risk. This is similar in other studies. There is a great deal of evidence to suggest that preparedness is the biggest concern for wilderness travelers. With SLCo rescue rates rising, it is time for an interventional program focused on preparedness. What aspect of preparedness should be focused on is still unknown. Three principles that could be focused on are a simplified essential pack list, steps to increase adherence to good planning technique, and critical decision making in the wilderness.

REFERENCES

Abbey, E. (1968). *Desert solitaire: A season in the wilderness*. New York, NY: McGraw Hill.

Askew, E.W. (2012). Nutrition, malnutrition, and starvation. In 6th ed. *Wilderness Medicine* (pp. 52-70). Maryland Heights, MO: Elsevier Ltd.

Boore, S.M., & Bock, B. (2013). Ten years of search and rescue in Yosemite National Park: Examining the past for future prevention. *Wilderness Environmental Medicine, 24*, 2-7.

Bureau of Land Management. (2014). Wilderness areas. Retrieved from: http://www.blm.gov/ca/st/en/prog/wilderness/wa.html

Ela, G.K. (2004) Epidemiology of wilderness search and rescue in New Hampshire, 1999–2001. *Wilderness Environmental Medicine Journal, 15*, 11–17.

Duncan, S., & Martin, S. R. (2002). Comparing the effectiveness of interpretive and sanction messages for influencing wilderness' visitors intended behavior. *International Wilderness Environmental Medicine Journal, 8*(2), 21.

Forrester, J.D, & Holstege, C.P. (2009). Injury and illness encountered in Shenandoah National Park. *Wilderness Environmental Medicine Journal, 20*, 318–326.

Heggie, T.M., & Heggie, T.W. (2009). Search and rescue trends associated with recreational travel in the US National Parks. *Journal of Travel Medicine, 16*, 23-27.

Heggie, T.M., Heggie, T.W., & Kliewer, C. (2008). Recreational travel fatalities in US national parks. *Journal of Travel Medicine, 15*, 404-411.

Heggie, T.W., & Amundson, M.E. (2009). Dead men walking: Search and rescue in US National Parks. *Wilderness Environmental Medicine Journal, 20*, 244–249.

Heggie, T.W., & Heggie, T.M. (2008). Search and rescue trends and the emergency medicine service workload in Utah's National Parks. *Wilderness Environmental Medicine Journal, 19*, 164–171.

Hung, E.K., & Townes, D.A. (2007). Search and rescue in Yosemite National Park: A 10-year review. *Wilderness Environmental Medicine Journal*, *18*, 111–116.

Johnson, R.M., Huettl, B., Kocsis, V., Chan, S.B., & Kordick, M.F. (2007). Injuries sustained at Yellowstone National Park requiring emergency medical system activation. *Wilderness Environmental Medicine Journal*, *18*, 186–189.

Kogut, K.T., & Rodewald, M. D. (1994). A field survey of the emergency preparedness of wilderness hikers. *Journal of Wilderness Medicine*, *5*, 171-178.

McIntosh, S.E., Brillhart, A., Dow J., & Grissom C.K. (2010). Search and rescue activity on Denali, 1990 to 2008. *Wilderness Environmental Medicine Journal*, *21*, 103–108.

Mountaineers, The. (2011). The ten essentials. Retrieved from: http://www.mountaineers.org/images/TenEssentials_web.pdf

National Park Service. (2013). National Park Service overview. Retrieved from: http://www.nps.gov/news/upload/NPS-Overview-2012_updated-04-02-2013.pdf

National Park Service. (2014). Hike smart podcast – What is PSAR? Retrieved from: http://www.nps.gov/grca/photosmultimedia/hike_smart-01.htm.

Subudhi, A. W., Askew E. W., & Luetkemeier, M. J. (2005). *Encyclopedia of human nutrition*. Miamisburg, OH: Elsevier Ltd.

United States Census Bureau. (2013). State and county quick facts. Retrieved from: http://quickfacts.census.gov/qfd/states/49000.html

United States Census Bureau. (2014) State and county quick facts. Retrieved from: http://quickfacts.census.gov/qfd/states/49/49035.html

U.S. Department of Health and Human Services. (2012). Health, United States, 2012. Retrieved from http://www.cdc.gov/nchs/fastats/overwt.htm

Utah Avalanche Center. (2014) Know before you go. Retrieved from: http://utahavalanchecenter.org/know-before-you-go.

Wild, F.J. (2008). Epidemiology of mountain search and rescue operations in Banff, Yoho, and Kootenay National Parks, 2003–06. *Wilderness Environmental Medicine Journal*, *19*, 245–251.

Yellowstone National Park. (2014) Visitation statistics. Retrieved from: http://www.nps.gov/yell/planyourvisit/visitationstats.htm.